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Regulations and Regulatory Issues

THE TENORM PAGE

U.S. Guidance

NCRP

The National Council on Radiation Protection and Measurements (NCRP) periodically updates its recommendations, including those germane to this discussion. NCRP published its Report 91 in 1987 (NCRP 1987) and was based on risk estimates given in ICRP 26 (ICRP 1977). NCRP Report 116 (NCRP 1993) was published to update the previous estimates and adopts the recommendations of ICRP 60 in general terms.

For human-made sources, annual dose limits for members of the public are 1 mSv (100 mrem) for continuous exposures and 5 mSv (500 mrem) for infrequent exposures. It is an ALARA standard, and has a constraint of 25% of the limit from one single source.

NCRP discusses instances when "natural radiation sources enhanced locally by man's operations for selected purposes, can give rise (sometimes quite inadvertently) to annual exposures above the level of 1 mSv.

It then becomes necessary to consider at what exposure level remedial action, which may only be possible at substantial societal cost, should be undertaken. Remedial action levels involve a balance of risk with many other socio-economic factors." Once a remedial action (intervention) level is set, exposures above that level should trigger action. Once remedial measures are invoked, the action should be ALARA driven, and obtain cleanup levels well below the action level, if appropriate. NCRP then goes on to recommend that "...remedial action be undertaken when continuous exposures from natural sources, excluding radon, are expected to exceed five times the average or 5 mSv (500 mrem) annually."

For purposes of TENORM, the recommendations are similar.

NCRP 118 ***Radiation Protection in the Mineral Extraction Industry*** **provides guidance for radiation protection practices at facilities that process various ores (NCRP 1993a).**

NCRP 118 is considered in the HPS/NORM working group recommendations (HPS 1998).

A committee has been formed to examine the linear dose response model (NCRP 1998), and is discussed in the section on risk.

Click here for a table of ICRP 60 and NCRP 116 risk and dose limits and a discussion on dose.

Other NCRP reports that are applicable to TENORM issues are:

- NCRP Report 94, *Exposure of the Population in the United States and Canada from Natural Background Radiation* (NCRP 1987),
- NCRP Report 95, *Radiation Exposure of the U.S. Population from Consumer Products and Miscellaneous Sources* (NCRP 1987a),
- NCRP Report 118, *Radiation Protection in the Mineral Extraction Industry* (NCRP 1993a),
- NCRP Report 121, *Principles and Application of Collective Dose in Radiation Protection* (NCRP 1995),
- NCRP Report 123, *Screening Models for Releases of Radionuclides to Atmosphere, Surface Water, and Ground* (2 Vols) (NCRP 1996),
- NCRP Report 129, *Recommended Screening Limits for Contaminated Surface Soil and Review of Factors Relevant to Site-Specific Studies* (NCRP 1999).

NATIONAL RESEARCH COUNCIL

The National Research Council (NRC), an arm of the National Academy of Sciences (NAS), conducts research on the Biological Effects of Ionizing Radiation (BEIR). For years, Congress has used the NAS to evaluate regulatory proposals. Currently, the NAS is being used to evaluate regulations proposed by the NRC.

BEIR V

BEIR V addressed health effects and risks due to low levels of radiation (NRC 1990). The report concludes that the carcinogenic effectiveness of low LET radiation is generally reduced at low doses and low dose rates. In comparing protracted versus acute exposures, protracted exposures are expected to reduce lifetime risks by a factor of about two for the same dose of low LET radiation. Due to the amount of new data available since the publication of BEIR V, a new committee is in process of evaluating the effects of low LET radiation. This BEIR VII report is due about five years after commencement, and will examine the dose-response relationship at low doses and low dose rates.

BEIR VI

BEIR VI, based on an earlier report, focused on risk factors associated with the inhalation of radon gas and radon gas decay products (NRC 1998). The report updated a previous report (NRC 1988) and concluded that (abbreviated):

- **reducing indoor radon concentrations below the EPA guideline of 148 Bq/m3 (4 pCi/L) could prevent approximately about one-third of the radon related lung cancer cases in the U.S.;**
- **lung cancer cases could be prevented most effectively by limiting smoking;**
- **a single alpha particle traversal in a cell can result in mutation and transformation.**

Federal Regulation of TENORM

In the U.S., as elsewhere, NORM and TENORM has often been defined by what it is not, rather than what it is. It has been defined by exclusion: it is not low level waste, nor is it source, special nuclear, or byproduct material under Atomic Energy Act.

The definition of source material found in the Atomic Energy Act (AEC 1972) is based on the early safeguards concerns for material that could be used to ultimately make reactor fuel or nuclear weapons. When the definition was written, Congress considered that source materials needed to be placed under regulatory control on the basis of promoting common defense and national security. The health and safety impacts from NORM other than source material were considered to be manageable, to be relatively insignificant, and to have no basis for regulation from the standpoint on the common defense and national security (USNRC 1996).

The hazards posed by uranium mill tailings (a byproduct material) were incompletely recognized in the uranium industry's early years, and, while the AEA of 1954 instituted licensing of mill operators, tailings remained free of controls.

When the Uranium Mill Tailings Remedial Action Control Act (UMTRCA) was passed in 1978, a new definition of byproduct material was created at section 11 e(2).

11 e(2)Byproduct material under the Act limited control to tailings "produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content" (EPA 1994). Therefore, other tailings (vanadium, radium, etc.) as well as other NORM bearing wastes are not regulated by the AEA, and are considered TENORM.

EPA Regulations

EPA and other Federal and State agencies are responsible for regulating public

exposures to NORM that are not licensed by NRC. State authority is derived from the Constitution, by which the States have primary responsibility for the health and safety of the public. EPA, State, and NRC programs do not treat the radiological risks from NORM consistently. NRC licensees generally are required to meet more restrictive conditions than are possessors and users of other NORM. There are no significant differences in the radiological risks of these materials, although radon and some discrete radium sources have a higher radiological hazard than uranium and thorium (NRC 1996).

Currently there are no federal regulations *specifically* controlling TENORM. However, numerous federal laws do regulate parts of the TENORM industry. An example is the NESHAPS for radon emanation from a mill tailings pile.

EPA has authority to protect the public health and environment from adverse affects of exposure to ionizing radiation. The authority to regulate TENORM is derived from several statutes, including the AEA; the Clean Air Act (CAA); UMTRCA (as mentioned before); The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); and the Toxic Substances Control Act (TSCA). The Resource Conservation and Recovery Act (RCRA) and the Solid Waste Disposal Act (SWDA) explicitly exclude source, byproduct, and special nuclear material (by definition), but they do not explicitly exclude NORM/TENORM. TSCA includes a subchapter on Indoor Radon Abatement, which was written with residential NORM (i.e., Rn) in mind (EPA 1993).

Federal Radiation Protection Guidance

> **"The purpose of the RPG is to provide a common framework to help ensure that the regulation of exposure to ionizing radiation is carried out by Federal agencies in a consistent and adequately protective manner." (EPA 1994). The current basis for radiation protection in the U.S. dates back to the RPG of 1960 and 1961. New Federal guidance issued in 1987 replaced those portions of the 1960 and 1961 guidance that applied to protection of workers.**
>
> **The RPG is 0.5 rem/year each to the whole body and bone marrow, and 5 rem in 30 years to the gonads. Additional RPGs at comparable levels are specified for exposure to the thyroid and bone (1.5 rem/year). In addition, doses should be "as low as reasonably achievable (ALARA) and advised that control should be applied to keep doses below the RPG, but that surveillance alone was sufficient for levels up to 10% of the RPG (Richardson 1995). It should be noted here that the RPG for the gonads was based on limiting the incremental rate of mutation in the entire genetic pool of the U.S. population. The incremental level of mutation deemed unacceptable was on the order of a few percent (EPA 1994).**

Richardson classified problems with the old RPGs into three categories:

- **Methodological problems - the approach used organ-specific limits and failed to address future commitments of dose from the intake of radionuclides;**
- **The guidance focuses on exposure of the individual and does not provide adequate insight on how to deal with the regulation of sources; and**
- **The permitted individual risk level is now considered to be far too high.**

These same arguments can be applied to the TENORM issue and are considered in the proposed standards.

Proposed RPG

In 1994, EPA proposed new RPGs replacing the 1960s vintage guidance. The guidance would reduce the dose limit to members of the public from 5 mSv (500 mrem) to 1 mSv (100 mrem), from all combined sources of radioactivity. It allows an annual dose of 5 mSv (500 mrem) for special and temporary circumstances involving infrequent radiation exposures. It requires that the RPG be expressed in terms of a single weighted sum of doses to organs, and the separate RPGs for individual organs be deleted; the RPG limiting the average genetic dose to members of the U.S. population to 5 rems in 30 years and the annual whole body dose to 500 mrem dose equivalent be replaced by a single RPG of 1 mSv (1 mrem) effective dose equivalent received by or committed in a single year to any individual from all sources combined; doses from individual sources be limited to a fraction of the RPG; and increased emphasis be given to ALARA, within the RPG (EPA 1994).

1994 Proposed RPG now withdrawn

The 1994 proposal has been withdrawn. A new effort is now being undertaken to revise the RPG by the Interagency Steering Committee on Radiation Standards (ISCORS) Federal Guidance Subcommittee. The main Federal Agencies will work on the new RPG, but unless the issue over the EPA and USNRC methodologies are resolved (15 mrem w/ 4 mrem from groundwater vs. 25 mrem from all sources combined), it may be a while before the RPG is reproposed. The group is "...taking a fresh look at the issues and is directly addressing concerns that surface through that process. The goal of our effort is to provide the public and regulated community with a consensus document from the federal government on principles for protecting the public from unnecessary exposure to ionizing radiation" (Rosenberg 2001).

Uranium Mill Tailings

In 1965, it was discovered by the Public Health Service (PHS) and the Colorado Department of Health that uranium mill tailings were being hauled from the mill site and used for construction purposes in around habitable structures (CDH 1989). Regulations were promulgated to effect cleanup for Grand Junction based on PHS recommendations, known as the Grand Junction Remedial Action Criteria, found at 10 CFR 712 (AEC 1972). These regulations were designed to mitigate radon in structures from uranium mill tailings. In 1978, the Uranium Mill Tailings Radiation Control Act (UMTRCA) was passed to address the mill sites themselves, as well as disposal of the tailings. The regulations supporting UMTRCA are found at 40 CFR 192 (EPA 1978).

These regulations are the basis for the current regulations for NORM the States have adopted, along with surface contamination release limits found in REG Guide 1.86 (NRC 1974). Final groundwater standards were promulgated in 1995 and are consistent with USNRC values found in 10 CFR 40.

Table 16. 40 CFR 192 Standards

Soil, ^{226}Ra averaged over 100 m^2, shall not exceed background by more than:	5 pCi/g ^{226}Ra averaged over the first 15 cm of soil below the surface 15 pCi/g ^{226}Ra averaged over 15 cm thick layers of soil more than 15 cm below the surface
Habitable buildings:	Annual average radon decay product concentration (including background) not to exceed 0.02 WL. In any case, not to exceed 0.03 WL Level of gamma radiation shall not exceed the background level by more than 20 micro roentgens per hour.

There are some things that need to be considered when adopting the 40 CFR 192 values to TENORM:

- **The limits were promulgated when radiation protection guidance in place at that time limited exposures to the public to ~5 mSv/year (500 mrem/year) whole body with limiting factors to critical organs. The proposed RPG is for an upper limit of ~1.0 mSv/year (100 mrem/yr) from all sources (60 FR 49296).**
- **The risks from low levels of radiation are assumed to be proportional to dose, that is, they are based on the linear no-threshold model. There is considerable debate over the validity of this theory (Patterson 1997).**
- **The limits in 40 CFR 192 were calculated using radon emanation values for sandy material. Many TENORM wastes have very low radon emanation fractions (slag).**
- **The indoor gamma exposure rate criteria of ~0.174 uSv/h (20 uR/h) above background was designed to allow some limited flexibility in the methods chosen to reduce indoor radon decay product concentrations, not to meet a certain dose limit. In fact, based on 75% occupancy, the standard would allow gamma radiation doses from the tailings of about ~1.13 mSv/year (130 mrad/year) (EPA 1980). Is this ALARA??**
- **The subsurface standard 555 Bq/g (15 pCi/g), is not a health-based standard, but instead is a instrumentation-based standard. It is not clear if the 555 Bq/g standard will survive.**

There is a good discussion of this topic in the TENORM report to Congress (NRC 1999).

CERCLA

NOTE: EPA recently published guidance on soil screening levels for soil.

EPA considered regulating TENORM in the first discussion draft of 40 CFR 196, but that rule was withdrawn (EPA 1996). It is possible in today's climate that TENORM

would be regulated. The NAS report on TENORM recommended that all radionuclides be regulated equally, including TENORM.

In practice, CERCLA is used for radioactive materials that:

- Were not subject to regulations before the passage of the AEA (example: FUSRAP sites being cleaned up by the Army Corps of Engineers - a subject of debate by many),
- Are presently unregulated (radioactive material that was never licensed or registered and they should have been), or
- Are outside the capabilities of regulators (lack of funding, staffing or capability to resolve the issue) (EPA 1996a).

CERCLA has been used at sites with byproduct material (EPA 1990). Examples are the Maywood, NJ site and the Monticello Site in Utah. EPA has recently issued guidance documents on implementing cleanup levels under CERCLA that are risk-based to a reasonably, maximally exposed individual.

Superfund issued a directive Use of Soil Cleanup Criteria in 40 CFR 192 as Remediation Goals for CERCLA Sites that clarifies when the UMTRCA standards can be used (EPA 1998, 1996). This is important to TENORM sites because many of the wastes are similar to uranium mill tailings in that they have Ra-226 as a principle contaminant.

EPA has started to re-evaluate risks from TENORM from various industrial sectors. They are addressing NORM on a sector by sector basis. According to the EPA web site:

"RPD's [Radiation Protection Division] strategy is a four-pronged approach to the problem:

- Study the TENORM-producing industries to determine what's in the wastes from the industries and how much risk they pose.
- Identify and study existing TENORM sites to assemble a nation-wide view of the problem--where the wastes are, what's in them, and the risks they present.
- Develop and provide education and guidance for safely and economically controlling exposures to TENORM wastes.
- Work with other organizations that are confronting the problem of TENORM, including states, tribes, other federal agencies, industry and environmental groups, and international organizations.

One such scoping document has been released, the *Joint NRC/EPA Sewage Sludge Radiological Survey: Survey Design and Test Site Results* (EPA 1999). Another recent report is the "*Technologically Enhanced Naturally Occurring Radioactive Materials in the Southwestern Copper Belt of Arizona*" (EPA 1999a).

EPA also has proposed to amend its RCRA regulations at 40 CFR 266 to provide increased flexibility to facilities that manage low-level mixed waste and NARM. The proposal will:

- **Allow on-site storage and treatment of the wastes at the generator's site,**
- **Require the use of tanks/containers to solidify, neutralize, or otherwise stabilize the waste,**
- **Only apply to generators who are licensed by NRC or an Agreement State,**
- **Attempt to exempt LLMW and hazardous NARM waste from RCRA manifest, transportation, and disposal requirements under the NRC or Agreement State regulations for LLW or NARM.**
- **Retain and amend the mixture and derived rule (EPA 1999b).**

USNRC

As mentioned earlier, USNRC regulates source, byproduct and special nuclear material under authority of the AEA. Byproduct material under USNRC control, i.e. Title II UMTRCA sites are regulated at 10 CFR 40.

The criteria for soil are the same as UMTRCA. Thirty States have entered into agreements with USNRC and have assumed jurisdiction over the use of byproduct material. The USNRC does not license TENORM, although many States believe they have authority over TENORM in their general rules on radiation.

Prior to the implementation of the revised 10 CFR 20 in 1996, the 1981 Branch Technical Position (BTP) addressed four options for disposal of uranium and thorium wastes (USNRC 1981).

Recent changes in USNRC policy on feed stocks for uranium mills has led to a series of reprossessing of industrial waste streams from non UMTRA sites to recover uranium. The wastes from these reprocessed materials are being disposed of in UMTRA disposal cells (USNRC 1995). NRC has determined that they do not have authority over pre-AEA wastes (such as much of the FUSRAP wastes). This is

causing consternation to some.

More on this to follow. Download my Waste Management '00 paper "Problems Associated with Disposal of Pre-AEA Byproduct Material"

It should be noted that the USNRC staff has been busy in the last few years consistently tuning their guidance on disposal of pre-1978 byproduct material (which is essentially TENORM since its out of supposed jurisdiction of the Commission and is not under Title I (the DOE portion) of the Act), but additionally they have been revisiting a number of areas dealing with TENORM and other uranium and radium bearing materials. The National Mining Association submitted a white paper dealing with four aspects of the TENORM/mill tailings issues. The Commission has been very receptive to the NMA wishes, and has been granting them steadily. They are currently evaluating the materials programs for many sectors.

DOE

DOE regulates source, byproduct, and special nuclear material through its directive system. Under DOE Order 5400.5, exposures to members of the general public are limited to an annual dose of 1 mSv (100 mrem) from all pathways, and all sources (DOE 1990). DOE has generic cleanup limits for radium and thorium based on the 40 CFR 192 criteria, with clarification on ingrowth, equilibrium, and hot spots. Authorized limits for other radionuclides are derived on a case-by-case basis.

DOE Order 5400.5 has been proposed to be codified at 10 CFR 834, but has yet to be promulgated (DOE 1993).

DOE manages its waste through DOE Order O435.1 (DOE 1999). It treats NORM that is commingled with regulated wastes as low level waste. NORM that is not commingled is exempt.

The Formerly Utilized Sites Remedial Action Project (FUSRAP) addresses the cleanup of former DOE facilities that had been previously released. Oversight of this program was transferred from DOE to the Army Corps of Engineer (COE) by Congress in 1997. Guidelines issued under the FUSRAP program are essentially the same as those found in DOE Order 5400.5.

However, the Corps is expediting cleanups at these sites, and are using risk-based cleanup levels at many of the sites. Furthermore, to save disposal costs, the Corps has sent some of the FUSRAP wastes to industrial landfills not specifically licensed for NORM. Other FUSRAP wastes have gone to Envirocare.

The DOE, which has a large inventory of stored solid material having low amounts of radioactivity from its various defense activities, has, as of January 12, 2000, instituted a moratorium on release of metals with volumetric residual radioactivity. DOE has also established a task force to review DOE policies on release of all materials for re-use and recycling which would include public participation. Check the scrap metal page of this site for more information.

States Regulation of TENORM

Many states consider TENORM to be regulated by their general rules on radiation. Other States believe that TENORM should have specific regulations. The Conference of Radiation Control Program Directors (CRCPD) has developed templates for States to use in drafting regulations for control and disposal of TENORM. The previous drafts were based on the 40 CFR 192 radium in soil values with exemptions, methods for licensing, protection of workers and general population, and disposal. The draft regulations have gone through many iterations.

Ten states currently have regulations pertaining to TENORM, most of them based on the old CRCPD template (AK, GA, LA, MS, NJ, NM, OH, OR, SC, TX). In addition to the soil criteria, some of the States also allow for clearance based on exposure rate. Michigan has promulgated regulations allowing disposal of up to 50 pCi/g 226Ra to be disposed of in a Type 2 Municipal Landfill. New Jersey standards are based on natural background. Mississippi, Texas and New Mexico allow for land spreading under certain conditions. Kansas has guidance for NORM, but specific regulations for it have not been promulgated. The States are listed in Table 17. CRCPD established a "blue ribbon" panel to work more efficiently and effectively to finalize the Part N suggested state regulations for the control of TENORM. The panel was made up of representatives of industries with TENORM and regulators. No members of the public or representatives of the environmental community are on the panel.

The panel released a new draft of the proposed State regulations in February 1997, the comment period ended June 30, 1997 (HPS 1997). A second draft was released in late 1998, which was controversial because it has been weakened considerably from the first draft, and has loopholes in it. The CRCPD adopted the standard on April 1, 1999.

Table 17. States with TENORM regulations

New Mexico	South Carolina	Mississippi	
Georgia	Arkansas	Louisiana	
Texas - Revised April, 1999!	Oregon	Ohio	New Jersey

Other states currently considering TENORM regulations are listed in Table 18.

Table 18. States considering TENORM regulations

Alabama	Alaska	Colorado
Connecticut	Florida	Illinois
Michigan	Oklahoma	

CRCPD Suggested State Regulations for Control of Radiation

Final draft adopted by the CRCPD Board - Now available from the CRCPD.

NOTE: Part N is now under review and rewriting. It should be re-issued sometime in 2001!

Some features of the template are:

- A new definition of what TENORM is: "naturally occurring radionuclides whose concentrations are increased by or as a result of past or present human practices. TENORM does not include background radiation or the natural radioactivity of rocks or soils. TENORM does not include uranium or thorium in source material as defined in the AEA and US NRC regulations."
- The limits in the standard are dose-based. The implementing State is to determine what fraction of 100 mrem/y total effective dose equivalent (TEDE) (excluding natural background) to the reasonably maximally exposed individual is allowed from TENORM.
- Exemption limit of 5 pCi/g 226Ra or 228Ra,
- Surface contamination guidelines follow REG GUIDE 1.86,
- Excludes indoor radon from TEDE calculations,
- States are given flexibility for implementing Part N consistent with their respective, unique circumstances,
- Safety criteria for products containing TENORM,
- Quality control, labeling and reports of transfer of TENORM,
- Implementation Guidance will be developed that will address issues such as determination of background, survey methods, etc.

The template does not address:

- liquid media (other than brief reference to CWA/SDWA for disposal),
- intervention by States (CERCLA would need to be invoked), or
- why Part N does not address radioactivity of material in its natural state that has been relocated (bringing subsurface NORM to the surface). Clearly, exposures to the public can occur from these activities.

Part O

The CRCPD is developing licensing requirements for decommissioning, under Part O, facilities and land contaminated with licensed radioactive materials. In addition to defining specific requirements, Part O presents radiological criteria for the unrestricted release of lands and facilities. The proposed limits are:

1 mSv (100 mrem) per year

5 mSv (500 mrem) per year provided that the licensee:

Demonstrates that further reductions in residual radioactivity necessary to comply with the 1 mSv criterion are not technically achievable, would be prohibitively expensive, and would result in net public or environmental harm;

Makes provisions for durable institutional controls; and

Provides sufficient financial assurances to enable responsible government entities or independent third parties to carry out periodic checks, monitoring, and maintenance.

Part O is based on the USNRC license termination criteria found at 10 CFR 20.

CRCPD has also published a characterization of TENORM-affected industries that provides alternatives addressing decommissioning (CRCPD 1994). The criteria focus is on oil and gas TENORM wastes, but may be applicable in a broader context.

The alternatives and criteria are:

Alternative 1 - Incremental lifetime risk rates for fatal cancers limited to 5.0 x 10-4 per rem and 440 -770 cancers per 1,000 persons exposed to 7.4 x 10+3 Bq/m3 (1 WL) radon. CRCPD also recommends that regulatory agencies initiate a consensus building effort to determine the level of risk that would be acceptable by the affected community.

Alternative 2 - Trivial annual doses limited to 10mSv (1 mrem) to the individual and a maximum annual collective dose of 10,000 person Sv (1,000 person-rem). In its consideration, the CRCPD rejected these limits on the basis of cost, but indicated that this alternative might be appropriate in a few specific instances.

Alternative 3 - Indoor radon limited to 148 Bq/m3 (4 pCi/L) for structures erected on land released for unrestricted use. Compliance with the MCLs of the CWA for sites with groundwater exposure pathways is also specified. An annual exposure limit of 1 mSv (100 mrem) from all sources, with 25% of the limit restricted to any single site. Contaminated equipment disposed of without removal of the contamination should be managed in a manner that makes their introduction in commerce or unrestricted use extremely unlikely. Contaminated equipment with radium concentration in excess of 185 Bq/g (5 pCi/g) should be disposed of in a manner meeting the above noted performance standards. Disposal of pipe scale in sanitary and industrial landfills should be evaluated to ensure that such facilities meet the recommended performance standards (HPS 1999).

HPS/ANSI Standard for NORM - Guide for Control and Release of NORM

In addition to the CRCPD efforts, the HPS has a working group that is developing an ANSI standard for control and release of NORM (HPS 1997a). The working group is comprised of representatives of industry and government. It does not have any representation from the environmental community on it either *(NOTE: I am a member*

of this committee through my work with ORNL, and hopefully Colorado, I am likely considered by some to be the environmentalist on the committee - Phil). **The standard is still in draft form, consensus has not been reached on all issues, however, some basic themes of the standard can be discussed (Dehmel 1997):**

- **Primary exposure limit of 1 mSv (100 mrem)/year. TEDE, above background to average member of critical group exposed under realistic conditions, does not include radon,**
- **Limit to be calculated over 1,000 years,**
- **Allows for institutional or engineered controls,**
- **Constraint of 0.25 mSv (25 mrem) per year above background from any single source of radioactivity,**
- **Sites with groundwater pathways use MCL for 226Ra and 228Ra at the point of use,**
- **Provisional limit for infrequent exposures to RME of 5 mSv (500 mrem)/yr during remediation of facilities contaminated by past practices,**
- **Surface guidelines adopted from draft ANSI N13.12.**
- **Outdoor radon limited to 20 pCi/s m^2, averaged over the entire area of the disposal unit, waste or material pile, or impoundment,**
- **Indoor radon limited to 4 pCi/L in areas that are occupied or occupiable,**
- **Dose limits for products or materials containing NORM.**

The HPS draft has been submitted to the Society (not the ANSI committee) for the first round of balloting. Comments are being reviewed, and a second draft will be submitted for balloting in 2001. Comments were not favorable on all facets, so changes are to be expected.

There are differences between the CRCPD template for State Regulations and the HPS Standard for the basis of regulating TENORM.

- **The HPS standard allows for the higher limit for interventions based on the current RPG. The CRCPD draft did not have this provision, and the API threatened a major lawsuit. The scenarios chosen by the modeler may eliminate many contaminated sites from being cleaned up.**
- **The HPS draft adopts the proposed surface and volumetric standards being proposed by ANSI. The values are more in line with the IAEA standards.**
- **The HPS draft adopts SDWA standards for radionuclides in water, it is not clear how CRCPD will incorporate contaminated liquids into their regulations.**
- **The HPS draft regulates radon for some situations, the CRCPD draft does not address radon in a comprehensive way.**
- **The HPS draft constrains any one source of TENORM to 25 mrem/y, the CRCPD draft allows the States more flexibility in choosing the constraint from any one source.**

- **The HPS standard recommends modeling doses based on the average member of critical group exposed under realistic conditions, the CRCPD uses the reasonably maximally exposed individual. This becomes important when deriving cleanup criteria.**

These issues will be addressed during the coming year. It is anticipated that these regulations will end up in litigation because industry does not want regulations, and will fight them no matter how reasonable they may be (NOTE: my opinion only - Phil).

HPS/ANSI N13.12

***The HPS has published an American National Standards Institute (ANSI) standard,* Surface and Volume Radioactivity Standards for Unconditional Clearance (HPS 1998a). The standard replaces Reg. Guide 1.86, which was instrumentation-based, not risk-based, and therefore may not be protective of public health. It adopts the effective dose definitions of NCRP 116 (NCRP 1993), which is compatible with ICRP 60 (ICRP 1990). It lists a primary dose criteria of 10 µSv/y (1 mrem/y), above background to an average individual in a critical group for the unconditional clearance of materials from regulatory control. It provides screening levels for surface and volume contaminated material and equipment, and clearance screening levels for soil. Current BSS clearance values are based on 10 µSv/y (1 mrem/y).**

Guidance Documents for TENORM

In addition to the CRCPD template for State regulations, some guidelines for the control, disposal, and release of TENORM are:

- *Guidelines for the Handling of NORM in Western Canada* (WCNC 1995),
- *Implementation Manual for Management of NORM in Louisiana* (LDEQ 1990).
- Texas also has published regulatory guides on conducting close-out surveys of open land areas and requesting release for unrestrictive use (BRC 1990).
- *Management of NORM in Oil and Gas Production.* (API 1993) by the American Petroleum Institute.
- NCRP 1993. *Radiation Protection in the Mineral Extraction Industry.* NCRP Report No. 118.

Recycling and Disposal of TENORM

Reuse of contaminated scrap metal is an industry unto itself and is the topic of much discussion. Scrap dealers and smelting facilities have detected the presence of radioactivity, including TENORM, in numerous shipments of scrap metals through the use of radiation detectors at their facilities. I maintain a section of the HPS Decommissioning Section's website on scrap metal and have it mirrored on this site Scrap Metal Recycling.

Envirocare of Utah owns a licensed facility for commercial TENORM disposal located in Clive, Utah. The licensing of this facility follows criteria similar to those pertaining to uranium mill tailings disposal.

The U.S. Ecology low level waste facility at Hanford will accept some TENORM wastes,

but with restrictions. Extra packaging, waste form, and design requirements may result in lower radon releases and waste leach rates. This option would be limited by cost and volume restrictions.

Newpark Environmental TENORM Processing Facility of Port Arthur Texas accepts TENORM wastes for processing for injection into deep wells.

Campbell Wells Corporation of Lafayette, Louisiana accepts TENORM and NOW for treatment and disposal.

Efforts have been made to convince NRC to allow disposal of TENORM wastes in 11e.(2) disposal cells. NRC staff published a notice in the Federal Register on September 22, 1995, stating that "Radioactive material not regulated under the AEA shall not be authorized for disposal in an 11e.(2) byproduct material impoundment" (NRC 1995). If the material is run through the mill to recover the uranium ,then the spoils can be disposed in the mill tailings impoundment.

This is being utilized in Utah, where IUC is recovering uranium from various wastes obtained from other industries. One instance has been challenged as sham recycling, because if the feed has RCRA waste in it, the mill cannot run the feed. The first feed had hydrofluoric acid in it a (RCRA-regulated wastes), but NRC and DOE performed administrative changes to allow the waste to be processed. More on this topic here.

There have been a number of cases where the improper disposal of TENORM wastes has resulted in increased levels of direct gamma exposure to individuals:

- In Montclair, New Jersey, radium-contaminated soil caused elevated gamma exposure rate levels. This project is now a CERCLA site; cleanup is under way (EPA 1990).
- Elemental phosphate slag used to construct roads in Pocatello, Idaho, has resulted in a doubling of the radiation levels in some areas.
- In Mississippi, the use of pipes contaminated with radium scale in playgrounds and welding classes has resulted in unnecessary exposures.
- Vanadium and radium tailings have been used in construction materials and have contaminated soil and groundwater.
- In the past, pipe scale residue was left on the ground at pipe cleaning yards or washed into ponds or drainage basins. Surveys showed that some locations exhibited external radiation levels above 2 mR/h and ^{226}Ra concentrations above 1,000 pCi/g.
- Oil field sludges often were dumped into waste pits. Both burn and brine waste pits have been used for disposal of sludges and production water residues. This past practice may lead to ground and surface water contamination. In addition, direct radiation exposures may have occurred to individuals working or living near the disposal pits.

Home Open

Last Updated: Friday, August 24, 2001 18:18:39

Rick Poeton

02/21/2002 11:26 AM

To: Brad Jackson/R4/USEPA/US@EPA

cc: Jon Richards/R4/USEPA/US@EPA

Subject: Re: Radium/Radiation PRGs/Cleanup Goals

The dose levels WERE NOT reconciled with the CERCLA risk range. It was understood early on that dealing with the problem in the context of CERCLA and using the CERCLA criteria would lead to the conclusion that risks in many homes were "unacceptable". Measured gamma dose levels in excess of 15 mrem/year and ranging into a few 100s mrem/year would be unacceptable in a CERCLA evaluation. But the consequent potential actions regarding homes (demolition, abandonment, major rehab) were simply not acceptable to the community. This is a clear case where the CERCLA process and decision criteria broke down. The community (with the complicity of the companies involved) could see where the process would take them and simply refused to go there. The decision was made not to address the problem under CERCLA but to work out an agreement with the companies in a different context (a RCRA Consent Order) and to develop voluntary guidelines for the public.

I have pointed this example out to the radiation risk folks in OERR more than once, making the point that their narrow construction of acceptable risk and dose means that there are cases like this where CERCLA doesn't work. Yet we felt the the issue could not simply be ignored. What we wound up doing (with help from ATSDR) was developing voluntary guidelines based on non-CERCLA sources such as ICRP, NCRP etc. We brought in the concept of ALARA, but in retrospect I think we could have done a better job along those lines. The problem is that although EPA incorporates ALARA one way or another into much of its radiation protection logic and regulation, there is no good detailed guidance on how to implement ALARA or decide what is ALARA in specific cases. In our case, it turns out the ALARA is the governing concept in decisionmaking and recommendations for the public. If I had it to do over, I would try to flesh out the ALARA logic and criteria in more detail to support the recommendations.

For their part, the OERR folks (correctly) see this as outside their CERCLA framework, and therefore do not view it as precedent. If the community perspective had been different (as I think yours may be), I suppose we might have been able to proceed under CERCLA. In that case, it is likely that investigation and decisions would have been straigtforward. Direct gamma radiation measurements would have been all that was needed to identify locations for remediation. Probably we could have made the case that slag roads were a small risk based on occupancy factors. For buildings where slag was incorporated into the structure, however, I think large scale remedial impacts would have been unavoidable.

One creative approach that we talked about but did not try is "risk exchange". The slag in homes (in our case) is a gamma source only with no real contribution to indoor radon. The houses, of course, all have some naturally occurring radon, the risks from which far exceed even the high gamma levels we were seeing in homes from slag. So one approach would be to evaluate the slag gamma risk but "remediate" it by reducing a "similar" risk (radon) in the same buildings. It would not take much radon reduction to make up for a hundred or so mrem/year of gamma. In effect this would reduce background as a substitute for addressing the "release-related" risk. I am not aware that CERCLA has ever done something like this. There are conceptual problems like: does this mean that a PRP could install smoke detectors or institute a "quit smoking" program instead of cleaning up a contaminated site? Nonetheless, it might be a way to keep the process under CERCLA but not wind up tearing down homes. It might also make sense to the public. And as part of a site-specific resolution to a difficult problem it might work.

I am also very interested in how Region 4 will handle a similar set of concerns. So keep in touch. Glad to discuss more detail if you want: 206-553-8633.